

Methylmercury exposure and effects on salmonid fishes in the Yuba River

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Public Comments

No public comments were received for this proposal.

Collaboration Panel Review

Proposal Title

#0266: Methylmercury exposure and effects on salmonid fishes in the Yuba River

Final Panel Rating
above average

Collaboration Panel (Primary) Review

Collaboration:

Will the results of the collaborative effort be greater than the sum of its parts? Is it clear why the subprojects are part of a larger collaborative proposal rather than several independent smaller ones?

above average

Good case made for value of this collaborative project.

Interdependence And Integration:

Does the proposal have an example that clearly articulates the conceptual model of each subproject and how they link together as a whole? Are the boundaries of the study plans focused and cohesive, yet well delineated? Is there a plan for potential differences in the stages of subproject completion times? Are there clear plans for analyses and interpretations which seek to identify and quantify relationships among the data collected in various subprojects rather than separate analyses for each subproject?

above average

Conceptual model well discussed, but Figure is missing. Study plans detailed and delineated. No plan for variation on completion times, analyses are described.

Project Management:

Is it clear who will be performing management tasks and administration of the project? Are there resources set aside for project management and time given for investigators to collaborate? Is there a process for making decisions during the course of the project? Are

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there acknowledgments of potential barriers to collaboration and explanations of how team members will overcome barriers particular to their institutions?

above average

Project manager is identified and resources are set aside.
Time is allocated for collaboration and regular coordination.
No discussion of overcoming barriers.

Team Composition:

Does the lead principal investigator have successful management history and experience leading collaborative teams? Is it clear that all key personnel are committed to making significant contributions to the project? Do team members have complementary skills?

above average

PI has successful history and experience. Key personnel are committed and have complementary skills.

Communication Of Results:

Is there a clear plan for comprehensive and cohesive reporting of project progress to the CALFED community?

above average

Dissemination of results: Data uploaded to BDAT and NWIS, presentations to American River Task Force, American River Conference, Sacramento Water Forum, CALFED Science Conference, American Geophysical Union, Geological Society of America, and AFS; a masters thesis, several peer-reviewed journal articles, reports to CALFED, and USGS fact sheets.

Additional Comments:

Collaboration Panel (Discussion) Review

Primary reviewer found most of the proposal to be Above Average, but some strange details in the proposal made it

Collaboration Panel Review

suspect. For example, some key figures were missing, but the study plans were detailed and project management and analyses were well described.

Secondary reviewer judged the USGS portion was well developed and synthesized, but UCD portion was not. Noticed that a similar proposal to this one was submitted to ERP. Found the same strange omissions, but wasn't sure how to interpret this.

Both reviewers agreed the proposal is Above Average, the only concern being the missing figure; the grossly misspelled name of key player made it seem that the submitted proposa was a "draft" version.

Technical Synthesis Panel Review

Proposal Title

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Final Panel Rating
adequate

Technical Synthesis Panel (Primary) Review

TSP Primary Reviewer's Evaluation Summary And Rating:

The main goal of this project is to determine if exposure to Hg and MeHg in historical gold mining areas would be an impediment to the reintroduction of Chinook and steelhead. The research would consist of a combination of measurements in the field and laboratory bioassays. Overall, this is a good proposal on an important and timely topic. While the approach (with a combination of field studies and laboratory exposures) is in principle a very good one, not all of the tasks are consistent with the goal of determining whether the Hg contamination will hinder the success of introducing steelhead and wild Chinook salmon. The use of Chinook salmon is not carried through in the description of the actual tasks (and in only some of the specific objectives), so it appears that the research will be done using rainbow trout only. And the tasks dealing with effects of MeHg on resident adult trout from sites with contrasting MeHg exposure are not relevant for predicting effects on fish that spend most of their adult life outside the river system (and thus would have much lower MeHg body levels). In addition, the MeHg-dosing of the eggs by injection is likely to produce results that are different than for eggs taking up MeHg through the chorionic membrane (this problem could e.g. be overcome by exposing eggs at the contaminated sites). There are some minor problems with the approach and methodology as well (including Hg-speciation

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Technical Synthesis Panel Review

artifacts from sample storage, lack of necessary details for various experiments, and some other issues pointed out in the external technical reviews). Figures 3-9 were missing from the proposal.

Additional Comments:

EXTERNAL REVIEWS: The external reviews differed in their overall evaluation of the project. Goals and objectives were generally considered to be clear and consistent. However, some of the specific objectives and tasks were not internally consistent with the overall objective of the proposal. Most of the objectives dealt with just the rainbow trout, and not the spring-run Chinook (which was to be used as a proxy for the fall-run Chinook). It was not clear whether results obtained with rainbow trout can be extrapolated to Chinook.

Justification was considered to be excellent. The research question posed is an important one. The overall conceptual approach was considered to be a good one and designed to answer the fundamental questions. Some components were to be considered problematic though; the lack of adequate discussion of the experimental design for the laboratory studies, the egg exposure in the laboratory by injection, the absence of parallel studies on chinook, and the justification on some of the endpoints measured on resident adult rainbow trout relative to the overall objective (adults have much lower MeHg concentrations from marine sources of food). More minor problems with the various tasks were also identified.

Feasibility was considered to be valid for some parts, but problems with some of the specific tasks were expected to affect feasibility for others. Problematic was also the absence of many references cited in the background information for specific tasks. Capabilities were considered to be excellent. The budget was generally to be reasonable and adequate, though charges for water samples (at \$825 each) and sediment samples (at \$582 each) seemed high.

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research would consist of a combination of measurements in the field and laboratory bioassays. Overall, this is a good proposal on an important and timely topic. While the approach (with a combination of field studies and laboratory exposures) is in principle a very good one, not all of the tasks are consistent with the goal of determining whether the Hg contamination will hinder the success of introducing steelhead and wild Chinook salmon. The use of Chinook salmon is not carried through in the description of the actual tasks (and in only some of the specific objectives), so it appears that the research will be done using rainbow trout only. And the tasks dealing with effects of MeHg on resident adult trout from sites with contrasting MeHg exposure are not relevant for predicting effects on fish that spend most of their adult life outside the river system (and thus would have much lower MeHg body levels). In addition, the MeHg-dosing of the eggs by injection is likely to produce results that are different than for eggs taking up MeHg through the chorionic membrane (this problem could e.g. be overcome by exposing eggs at the contaminated sites). There are some minor problems with the approach and methodology as well (including Hg-speciation artifacts from sample storage, lack of necessary details for various experiments, and some other issues pointed out in the external technical reviews). Figures 3-9 were missing from the proposal.

Technical Synthesis Panel (Discussion) Review

TSP Observations, Findings And Recommendations:

Methylmercury Exposure and Effects on Salmonid Fishes in the Yuba River

The panel felt that, in general, this would be a study on an important topic. The panel liked that the researchers are proposing both field and lab studies.

The panel liked the fact that the researchers in the field portion of the study would be measuring MeHg at the spawning redds, but felt that the study's justification would have benefitted from a preliminary analysis of MeHg in the

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hyporheic zone and a more extensive discussion of the hyporheic processes related to MeHg formation.

A major problem was that it was very difficult to evaluate the proposed methods because of a lack of detail. For instance, several figures (including one figure with sampling design) were not included.

The panel identified some potential problems with lab and field methods, in part because insufficient detail was provided.

Rating: adequate

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proposal title: Methylmercury exposure and effects on salmonid fishes in the Yuba River

Review Form

Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	<p>The goals, objectives, and hypotheses are clearly stated, and are timely and important to the objectives of the CALFED Science Program—specifically, to determine if mercury contamination and associated methylmercury in historical gold mining areas of the Sierra Nevada affects salmonids (steelhead trout and spring-run Chinook salmon) and if it poses a risk to reintroduced populations of anadromous fishes. This is important information required to make informed decisions regarding habitat restoration for anadromous salmonids in areas affected by mercury contamination from historical mining.</p> <p>However, the specific hypotheses and tasks are not internally consistent with the overall objective (6) of the proposal “To determine whether or not mercury and methylmercury exposure from historical gold mining is likely to affect the success introduction (or reintroduction) of wild Chinook salmon and steelhead trout in the Sierra Nevada”. The proposal indicates that rainbow trout and fall-run Chinook salmon will be used as proxies for steelhead and spring-run Chinook salmon. This is a good</p>
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	idea and I would expect the results to directly applicable to the respective target fish of concern. Hence, I am lead to believe that studies will be conducted on both proxy species. But, Objectives 2 through 5 and Hypotheses 1 through 7 focus on rainbow trout only. Hypothesis 1 indicates that methylmercury in redds of rainbow trout and Chinook salmon will be quantified, but field studies and laboratory experiments will be conducted on redds, eggs, etc. of rainbow trout only. There is no indication that parallel field studies and laboratory experiments will be conducted with fall-run Chinook salmon. Are results obtained from studies with rainbow trout applicable to Chinook salmon?
Rating	very good

Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full-scale implementation project justified?

Comments	The study is well-justified relative to existing knowledge about routes of exposure, the potential effects of methylmercury to sensitive developmental stages of salmonids, and important and relevant biological effects. The proposal does an excellent job of justifying the importance of this type of study and the potential ramifications the results have on future management decisions regarding habitat restoration and species reintroduction. Moreover, the background information and literature review that provides background information to support the various tasks and subtasks is current and germane to the proposal. The biological
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	endpoints to be measured are important and there is good documentation to demonstrate their relevance to the stated project objectives.
Rating	excellent

Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

Comments	<p>The overall conceptual approach for the study is very good and is designed to answer two fundamental questions. (1) What are the concentrations of methylmercury in salmonid eggs in areas contaminated with mercury from historical mining? (2) Do these concentrations affect development or have other lethal and sublethal affects on the fish that develop from these eggs. This will be determined by a series of mensurative field studies to determine levels of methylmercury exposure and effects (in part) in the field and manipulative laboratory experiments on rainbow trout eggs and juveniles.</p> <p>What is more problematic and hinders, in part, an assessment of the feasibility of the approach for meeting the proposal objectives is (1) the lack of adequate discussion of the experimental design for the laboratory studies and (2) methods of egg exposure in the laboratory, (3) absence of any parallel studies on chinook salmon, and (4) justification of some of the endpoints measured on resident adult rainbow trout relative to the objectives of assessing risk to anadromous species in which adults have much lower concentrations of methylmercury from marine sources of food.</p> <p>Minor comments on various tasks are as follows:</p>
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Task 3. Water Sampling and Analysis "Pore water samples will be collected from redds at critical lifestage intervals". This is vague. What are "critical lifestage intervals"? I.E., How many samples and at what intervals?

How will pore water be collected from the redds? This is not described. I assume that clean techniques will be used in the collection of water samples, but this is not mentioned.

Subtask 5A.

Based on previous experience, is a sample size of 10 adult trout and 10 YOY trout a sample size large enough to provide an estimate of Hg concentration with enough precision to differentiate between sites upstream and downstream from known mercury sources? This can be demonstrated by power analysis of data collected previously on Yuba River.

Will aquatic insects be analyzed as a group for Hg or will they be separated by species or functional feeding group? Mercury concentrations and relative methylHg/total Hg ratios would be expected to vary with trophic position.

Subtask 5B

It is important to evaluate the effects of Hg bioaccumulated in the redd to toxicity of trout and Chinook salmon. However, as the eggs exposed to methylmercury in this subtask will also be used in other subtasks (e.g., 5C), a much better description of the experimental design is warranted. Number of replicates, etc.

I think the method of methylHg exposure to the eggs is also problematic. Injecting methylHg into eggs will not result in the same time course of uptake as eggs in the redd (i.e., continuous uptake during

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incubation). Hence, I'm not convinced (without additional information or references) that injected methylHg will have same distribution kinetics and effects as chronic exposure from uptake via the chorionic membrane. Since the assumption is that the majority of methylmercury in the eggs is from aqueous exposure, why not expose the eggs to aqueous methylmercury in the hatching jars or take eggs from the natural and artificial redds from the field? Will hatching success of eggs in the laboratory and field be evaluated relative to Hg exposure? This is an important endpoint and easily measured, but is not mentioned.

Subtask 5C

Again, this section is conceptually very good, but lacks an adequate description of the experimental design.

Subtask 5D

What size or life stage of rainbow trout will be collected? If adults, why? Steelhead and Chinook adults are non-resident and would only be present in stream for short period (relative to life span) for spawning. A more extensive justification for this portion of this subtask is needed.

Why are hormones on adult rainbow trout being analyzed? Again, would one expect concentrations of mercury in Chinook and steelhead trout to be as high as those in resident rainbow trout? If not, then how is assessing reproductive health of resident fish relevant to hypotheses? Moreover, this is a mensurative field study and if T and E2 are suppressed at one or more locations, will there be a large enough range of methylmercury concentrations in the resident fish to demonstrate that methylmercury is the cause? If T and E2 suppression are important, than this should be experimentally evaluated in a manipulative

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	<p>laboratory study.</p> <p>Subtask 5E.</p> <p>Conducting histological and immune function response of YOY fish makes sense. Conducting this analysis on adults does not, relative to objectives and hypotheses of this study for the same reasons outlined in comments on Subtask 5D.</p> <p>The experimental design of the disease challenge test is dependent on that for Subtask 5B. Again, this needs to be better described.</p>
Rating	good

Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success?
Is the scale of the project consistent with the objectives and within the grasp of authors?

Comments	<p>My assessment of the project's feasibility is somewhat redundant with my assessment of the project's approach. The objectives and methodologies are fully documented and there is a high likelihood of success for obtaining the individual measurements. However, the likelihood of success in meeting the overall objective of the project is dependent, in part, on the approach. My concerns are indicated in that section.</p>
Rating	good

Monitoring

If applicable, is monitoring appropriately designed (pre-post comparisons; treatment-control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

Comments	Not applicable
Rating	not applicable

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Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

Comments	Conceptually, information from this project would aid managers in evaluating the potential risk that mercury contamination from historical mining poses to anadromous salmonids after habitat restoration.
Rating	excellent

Additional Comments

Comments	Figures 3 to 9 were missing from the proposal. The majority of the references cited in the background information for the various tasks and in the specific task descriptions were missing from the literature cited section.
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Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

Comments	The PIs have excellent experience, credentials, and track record of success on previous projects. They have developed a skilled interdisciplinary team of scientists and have the infrastructure and support network necessary to accomplish the project.
Rating	excellent

Budget

Is the budget reasonable and adequate for the work proposed?

Comments	
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	The budget is generally reasonable and more than adequate for the proposed work. Estimates of personnel, travel, and supply costs appear reasonable. However, laboratory charges for water samples (\$825/sample) and sediment samples (\$582/sample) seem high. Why are trace metals, nutrients, and other characteristics (if any) being measured that not directly relevant to the hypotheses about mercury effects on salmonids?
Rating	good

Overall

Provide a brief explanation of your summary rating.

Comments	I would give this proposal an overall rating of good to very good. Conceptually, the proposal will provide needed information for managers making decisions on habitat restoration projects for fish in streams subject to mercury contamination from historical mining. This is an excellent objective. The success of the proposed project for providing this information is dependent, in part, on the experimental design of the laboratory studies. This component of the proposal needs additional development and refinement. In addition, the proposal could provide better justification for measurements of the health assessment of adult rainbow trout in the field. Moreover, contrary to the proposal objectives, the laboratory studies (and field?) are directly applicable only to steelhead trout, but only indirectly applicable to the chinook salmon. Parallel laboratory studies should be conducted with chinook salmon.
Rating	good

Technical Review #2

proposal title: Methylmercury exposure and effects on salmonid fishes in the Yuba River

Review Form

Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	Sublethal impacts of Hg exposure on salmonids are an important consideration for restoration of endangered salmonids. Restoration opportunities may arise in habitats that are Hg-contaminated, though it is unknown if or how contamination limits restoration potential. The proposed goals are straightforward and are clearly stated, and this work has the potential to directly contribute to on-the-ground restoration at this site. The implications of this work are far-reaching, as early stages of fish in many other areas are subject to Hg exposure. The local and general applicability of this work is another strength.
Rating	excellent

Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full-scale implementation project justified?

Comments	The research question posed is an important one, and addresses an important gap in scientific knowledge. Restoration of habitat for migratory salmonids needs to consider the possibility that contaminants such as Hg could hinder restoration options, particularly in contaminated rivers such as the Yuba. The proposed
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Technical Review #2

	work also seems to be in line with CALFED objectives and priorities.
Rating	excellent

Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

Comments	The proposed project does a very good job at integrating a diverse range of approaches to address an important question. Importantly, the proposed work is designed such that it will actually provide evidence for whether or not Hg exposure may have impacts on salmonids in real ecosystems. An important strength is that a range of methods and endpoints are being used. The methods proposed are both innovative and thoughtful, while at the same time, the approaches being proposed already exist, and are not overly experimental.
Rating	excellent

Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives and within the grasp of authors?

Comments	Description of methods is adequate, and the approaches being proposed are all scientifically feasible. Likelihood of success is high. It seems as if the project is well designed for answering the questions being posed.
Rating	excellent

Technical Review #2

Monitoring

If applicable, is monitoring appropriately designed (pre–post comparisons; treatment–control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

Comments	The greatest value of this work is the potential for guiding restoration of salmonids in potentially contaminated habitats. The work also draws upon previously collected Hg data for the biota, which allows for an experimental design that maximizes the natural range in Hg levels within this system.
Rating	very good

Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

Comments	The most important product will be more effective restoration of endangered fishes, in the Yuba and elsewhere. We do not know to what extent contaminant exposure limits recovery. Another product will be an improved general understanding of sublethal effects of Hg exposure on early life stages of salmonids. One comment - if there are minor sublethal effects, this would not necessarily mean that salmonids cannot persist. How this information would be used in the restoration context is not addressed.
Rating	very good

Additional Comments

Comments

Technical Review #2

Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

Comments	The investigators have strong track records, and are well-suited for the proposed work. The project involves many researchers who are considered leaders in their respective fields.
Rating	excellent

Budget

Is the budget reasonable and adequate for the work proposed?

Comments	Budget seems appropriate, considering the magnitude of the proposed work.
Rating	excellent

Overall

Provide a brief explanation of your summary rating.

Comments	The components of the project seem well-integrated and complement each nicely. The study is designed such that it will provide important information that is useful for specific management questions. It will also contribute to general scientific knowledge.
Rating	excellent

